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PROBLEMS OF SEXUAL AND ASEXUAL REPRODUCTION.

Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere. By Prof. E. Korschelt and Prof. K. Heider. Erste und Zweite Auflage, Allgemeiner Theil, Vierte Lieferung. Erste Hälfte. Pp. 167–470. Price 7.50 marks. Zweite Hälfte. Pp. 471–896. Price 11 marks. (Jena: Gustav Fischer, 1910.)

EMBRYOLOGISTS who are already acquainted with the "Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere"—and what embryologist is not?—will welcome with delight the appearance of these further instalments of the "Allgemeiner Theil." No pains have been spared in the preparation of these two volumes, and authors and publishers alike are to be congratulated on their achievement.

In the first the student is introduced to the earliest important phase in the differentiation of the sexually produced individual organism—the formation of those "elementary organs" long since known as the layers of the germ. An admirably lucid account is given of the various types of "gastrulation," or endoderm formation, and this is followed by a description of the development of the mesoderm. The latter part of the treatise is devoted to the study of the peculiarities of these processes in certain special groups, Sponges, Arthropods, and Chordates (Cephalochorda and Urochorda).

It seems almost ungenerous to criticise where the general level of attainment is so high, but we confess that we should have liked to see the Vertebrates included in the last chapter—the method of closure of the blastopore, its relation to the chorda and neural plate are so similar in all these forms—and it is certainly a pity that no attempt has been made to deal with the derivation of the Amniote from the conditions found in Anamnia—a problem long the despair of embryologists, but now happily solved with the help of the Gymnophiona. And we might venture to remark perhaps that Fig. 154A, on p. 248, is incorrect in not exhibiting the bilateral structure of the egg, due to the formation of the gray-crescent on fertilisation. These, however, are matters that hardly mar the excellence of the book.

The second volume makes even more fascinating reading. One by one we are shown, in the groups of the animal kingdom, the details of the mechanism by which a new individual is produced from a bud, processes simple enough in some cases, but often presenting the most amazing complexities, which reach their acme in the Ascidians, while at the same time they defy—notably in Polyzoa and Ascidians again—the rules observed in sexual reproduction, and challenge the observer to frame any formula which will embrace the infinite variety of their behaviour.

But description is but the beginning of embryology, as of any other science, and the baffling problems presented by the germinal layers will assuredly only yield, if at all, to the experimental method. The results which that method has obtained must indeed form the starting point of any discussion, the basis of any theory of the part played by these "elementary organs" in development.

The old germ-layer hypotheses, which all more or less trace their lineage back to Haeckel's famous "Gastræa-Theorie," assume that the stage at which these sets of cells are segregated is of phylogenetic significance, reminiscent of some bygone ancestry, and that there is a general agreement not only in the way in which the layers originate, but also in the structures to which they eventually give rise, as is, of course, necessary for the hypothesis.

And though the authors of this treatise very properly define the germ-layers as the rudiments of definite body tissues in normal development, they are yet concerned to attempt some defence of a position which is no longer tenable.

Even in sexual reproduction there are too many refractory facts: thus, a two-layered condition is not necessarily a separation of endoderm from ectoderm (Placental Mammals, Cestodes, Phylactolæmata), the gut of Cœlenterates is formed in various ways, and so in Vertebrates the roof and floor of the archenteron play varying parts in the formation of that organ, while in those groups in which the egg segments according to the "spiral" type, it is by no means necessary that a cell or cell-group which has a definite place and time of origin in the cleavage system should invariably give rise to the same larval or embryonic part, though, it is true, this usually occurs. The cell 4*d*, for instance, is not always mesoblastic, and even when it does give rise to the mesoblastic bands the destiny of those structures may be variable. In Annelids, the cœlom is developed in them, in certain Mollusca they break up into connective tissue while the (cœlomic) pericardium has another (ectodermal) source.

These are only a few instances. When, however, we turn to the conduct of the layers in budding matters are infinitely worse. In Polyzoa the whole of the alimentary canal is of ectodermal origin; in Turbellarians nervous system and pharynx are mesodermal; in Annelids the pharynx is endodermal, all these organs being in sexual reproduction developed from the ectoderm. In Cephalodiscus the gut is ectodermal instead of being derived from the parental endoderm. In the Tunicata these anomalies attain the perfection of irregularity. The nervous system may be ectodermal (Botryllidæ), endodermal (other Ascidians), or mesodermal (*Pyrosoma,* Salps, Doliolidæ). The atrium may be ectodermal (Botryllidæ), endodermal (other Ascidians), or mesodermal (*Pyrosoma,* Salps), while the pharynx may be ectodermal (Botryllidæ, Doliolidæ), or endodermal (other Ascidians).

These facts, as the authors admit, nay insist, are indisputable, and absolutely irreconcilable with the requirements of the ordinary germ-layer theory.

An effort is indeed made to save the situation by minimising the discrepancies that occur in the course of sexual reproduction, and removing the facts of

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budding to another category. The writers, in fact, suggest that the phenomena are not coordinate, and that there would have been no difficulty had not "prospective significance" been confounded with "prospective potentiality." That is, it is the peculiarity of a bud to contain sets of cells which have greater capacities than the embryonic layer from which they were derived in the other manner of development. And yet, when it becomes necessary, to find some general expression for the different modes of endoderm formation in Cœlenterates, to deduce them all from some common origin, the "prospective significance" is enlarged until it is big enough to include as much "potentiality" as may be required!

The truth is that the anomalies are of the same order in both kinds of reproduction. In both the germ-layers have greater potentialities than they normally display, and no theory of them can ever be satisfactory that does not offer a general explanation of their origin and differentiation, in the development of the ovum, in budding, and in regeneration.

To the phenomena of the last two kinds the test of experiment has, as yet, scarcely been applied, but we do fortunately know what the internal factors are on which the differentiation of these first-formed embryonic organs in the ovum depends. For experiment has shown us that there are in the cytoplasm of the unsegmented egg-cell certain substances—at least certain regions—the removal of which entails the absence in later development of some particular embryonic or larval structure. The position of these substances in the ovum need not be that in which the corresponding organ eventually appears (the apical sense organ of *Dentalium* depends on something present in the polar lobe of the egg), and the manner in which this heterogeneous cytoplasm is cut up into cells during cleavage is largely irrelevant, the cleavage pattern being alterable, and, further, determined by other, distinct, causes. Hence, though normally these organ-forming stuffs pass into definite cells, though in related forms the cleavage pattern is alike, but not identical, though in related forms the arrangement of the stuffs and the differentiation of the organs is alike but not identical, nevertheless variations in the cleavage unaccompanied by corresponding variations in the cytoplasmic structure (or the converse), necessarily lead to the production, in related forms, of the same organ from a cell which has in cleavage a distinct origin. The illustration applies primarily to "spiral" cleavages—the nephridia of Leeches comes from 4*d*, of Annelids from 2*d*, the pericardium of some Mollusca from ectoderm, of other Mollusca and of Annelids from mesoderm (4*d*), and so on—but, *mutatis mutandis,* may be easily extended to other cases.

In truth, the substances out of which genuinely homologous, that is, phylogenetically homogeneous organs are developed, must be themselves homologous. They exist in the egg antecedent to segmentation and gastrulation, and cannot be created by those processes, in which therefore we look in vain for any absolute criterion of homology.

What experiment has done for the developing ovum it will, we hope, before long accomplish also for the bud and the regenerating organism. Then, but not until then, shall we know what the internal factors of differentiation are in these cases also, and shall be able perhaps to show that the primary—eventually all—the phenomena of their "increase of structure" are determined by the same kind of material (ultimately physical and chemical constitution), as that on which they are dependent in sexual reproduction.

WEBSTER'S NEW INTERNATIONAL DICTIONARY.

Webster's New International Dictionary of the English Language. Based on the International Dictionary of 1890 *and* 1900. *Now completely revised in all Departments, including also a Gazetteer and other Appendices.* Edited by Dr. W. T. Harris and F. S. Allen. Pp. lxxx+2620. (London: G. Bell and Sons, Ltd.; Springfield, Mass, U.S.A.: G. and C. Merriam Company, 1911.) Price 2*l*. 13*s*. 6*d*. net.

THE origin of "Webster" dates from a notable period in the history of works of reference, the second half of the eighteenth century. Noah Webster, a teacher in the United States, entered upon his earliest work of compilation about the same time that "a society of gentlemen in Scotland" were producing the first edition of the *Encyclopaedia Britannica* in Edinburgh. His spelling book appeared in 1783; it doubtless contained the germ of his larger idea, though this was not developed for many years—the first edition of his dictionary only appeared in 1828. Apart from re-issues and supplements (and also, to judge from a warning in the prospectus, pirated editions), there have been two great revisions of the original work before the present one, namely, those of 1864 and 1890. Both in the method of presenting facts and in mechanical construction the "new" revision introduces changes so great as to justify the use of the epithet in every sense, and some of these changes are of much importance and interest to all who have been led by frequent use to formulate views on the right arrangement of works of reference.

In the first place, "Webster" is an "encyclopædic" dictionary, and in the present edition that quality has been not only sustained but brought into greater prominence. At one period in the history of the making of works of reference, strong criticism was directed against the encyclopædic type of dictionary, and on obvious grounds. It was held to be the function of a dictionary exclusively to state and account for, historically and philologically, the origin and meaning of each word, to attempt no disquisition as to its connotation, and to avoid any articulated arrangement of historical, scientific, or other information dependent upon any word as a "heading." This latter function was left to the encyclopædia exclusively. Proper names and place-names were ruled out on the same grounds. On the other hand, the encyclopædia did not trench upon the philological functions of the dictionary, nor even, to any

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